Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
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In the Matter of	)	
	)	
Federal-State Joint Board on	)	CC Docket No. 96-45
Universal Service	)	

FURTHER COMMENTS

BellSouth Corporation and BellSouth Telecommunications, Inc. ("BellSouth") in response to the Public Notice (DA 96-1094), released July 10, 1996, hereby submit further comments on the cost models filed in CC Docket No. 96-45.

I. INTRODUCTION

As pointed out in the Public Notice, two cost models were submitted with the initial round of comments in this proceeding, the Cost Proxy Model ("CPM") and the Benchmark Cost Model ("BCM"). Subsequently, the BCM model has been revised and the new version, Benchmark Cost Model 2 ("BCM2") has been filed with the Commission. In addition to the CPM model and the two BCM models, a model developed by Hatfield Associates, Inc. ("Hatfield Model") has been filed for consideration by the Federal-State Joint Board in formulating recommendations on Universal Service. In issuing the public notice, the Common Carrier Bureau invites interested parties to comment on these models. While BellSouth discusses each of these models below, at the outset it should be reiterated that in determining universal service support, embedded costs of the incumbent local exchange carrier should be used. Such costs reflect the costs of the network that is in place and used to provide universal service. In contrast, the cost models are proxies for the actual costs local exchange carriers incur in providing universal service and yield costs that are theoretical in nature and that are based on a hypothetical network.[1]

If the Joint Board were to recommend the use of a proxy model, it should follow the guidelines outlined in BellSouth's August 2, 1996, comments in this proceeding. The essential corollary to implementing a proxy cost model is that it be accomplished in a revenue neutral manner Keeping this principle in mind, some models are better than others. These comments identify the relative strengths and weaknesses of the four cost proxy models.

II. DISCUSSION

A. BCM

The purpose of the original BCM was to provide a model that would identify areas that were, in comparison to other areas, relatively high cost to serve.[2] The BCM was never intended to estimate the actual costs of providing universal service. Apart from its limited purpose, BellSouth has pointed out to the Commission the flaws in the BCM that

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[1] On July 8, 1996, in connection with CC Docket 96-98, BellSouth submitted a paper prepared by Strategic Policy Research that included a description of a top-down approach to cost estimation. An important characteristic of the top-down approach is that it reflects network costs as they actually exist. See John Haring, Calvin S. Monson and Jeffrey H. Rohlfs, "Comments on FCC's Industry Demand and Supply Simulation Model," attached to BellSouth's Comments, CC docket 96-98, July 8, 1996.

[2] See e.g., Joint Submission by MCI Telecommunications Corporation, NYNEX Corporation, Sprint Corporation, and US West, Inc., in CC Docket 80-286, September 12, 1995 at 3.

diminish the model's usefulness even for the limited purpose of identifying areas whose costs are high in a relative sense.[3] The flaws in the BCM include:

1. The model's results are biased toward very sparsely populated areas. It estimates very high costs in areas such as National Parks, mountainous areas, deserts and other lightly populated areas.[4] This result is due to the model's assumption that all households are evenly distributed throughout the census block group in which they are contained. The fact, however, is that households in these areas tend to be clustered in relatively small parts of the census block group.

2. The model fails to include drop wire and terminal expenses resulting in a tendency in the model to underestimate the cost of local exchange service.

3. The BCM uses census block groups as the area within which it calculates local exchange costs. Local exchange networks, however, were constructed and, hence, costs incurred, on a wire center basis. There is no relationship between wire centers and census block groups. Often a census block group will contain areas from several different wire centers.

4. The BCM assigns a census block group to the wire center closest to the centroid of the census block group. This approach results in many census block groups being assigned to the wrong wire center. For example, BCM assigns approximately 16-20% of the census block groups to the wrong wire center in BellSouth states.

5. The BCM did not include business lines in sizing plant.

B. BCM2

BCM2 was developed in response to the criticisms of the original BCM. Overall the modifications reflected in BCM2 improve the model considerably and bring the proxy costs for each state more in line with each states actual costs. Nationwide, the net effect of the modifications was an average increase in cost of $6.94 per line, per month. In

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3 <u>See</u>, Comments of BellSouth Telecommunications Inc., CC Docket No. 80-286, filed October 10, 1995.

4 On the other hand, the model tends to produce costs that are lower than actual book costs in urban. suburban and even some rural areas.

addition, these modifications changed the relative cost relationships between urban and sparsely populated areas and between regions of the country.[5]

The principle modifications reflected in BCM2 are:

1. BCM2 makes an adjustment in determining the location of households in sparsely populated areas (less than 20 households per square mile). It assumes that inhabitants live within 500 feet of established roads instead of assuming that households are evenly distributed throughout the area. Because density is a key cost driver, BCM2 reduces the cost estimate of sparsely populated areas and brings the estimated cost more in line with actual costs.

2. BCM2 includes dropwire and terminal investment, which averages approximately $200 per access line, that was mistakenly excluded from the original BCM model.

3. BCM2 estimates expenses with greater granularity. The original BCM estimated annual costs by applying a single factor to investment. Such an approach incorrectly assumes that all expenses are a function of investment. It misses the fact that some expenses are incurred on a per line basis. BCM2 takes into account the relationship between lines and expenses. In addition, it employs three annual cost factors: (1) a cable and wire factor; (2) a circuit equipment factor; and (3) a switching equipment factor

4. BCM2 takes into account economies of scale that arise from providing business lines in a given area and thereby improves the model's estimating quality

C. **CPM**

To assist the Joint Board in its evaluation of the CPM model, BellSouth estimated results for Georgia and Florida based on the CPM methodology.[6] In order to estimate results for Georgia and Florida, the investment and engineering data resident within the

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[5] These changes are shown on Map 1 contained in Attachment 1.

[6] Specifically, BellSouth contracted with INDETEC to perform the calculations. INDETEC is the consulting firm that assisted Pacific Bell with the development of CPM.

model was used in conjunction with mapping and terrain data that are specific to Georgia and Florida. This analysis produced the following results:

STATE	BELLSOUTH AVERAGE COST	STATEWIDE AVERAGE COST
FLA	$29.69	$31.45
GA	$32.03	$36.23

There are several positive features associated with the CPM model that are not found in the BCM2 model. The first is that CPM uses grid cells as its geographic area. A grid cell, which is about a 3000 by 3000 foot square, represents a uniform and relatively small geographic area. This reduces the magnitude of the problem of a grid cell crossing wire center boundaries Further, a grid cell can be assigned to the wire center that actually serves the centroid of the grid cell rather than having to assign the geographic area to the nearest wire center as is the case for BCM2. Lastly, grid cells lend themselves to considerable cost disaggregation.

BellSouth has also compared the results of the CPM and BCM2 models for Florida. While generally, the CPM model produces higher results (See Attachment 2),[7] when the two models are compared on a wire center basis, there is a similarity between the two models (See Attachment 1, Map 2). For approximately 77 percent of BellSouth's wire centers in Florida the CPM and BCM2 models produce results that are within 15 percent of each other.[8] The comparability of the results between the two models is an

[7] Attachment 2 also shows the results of the original BCM, Hatfield model and BellSouth's embedded cost approach for Florida and Georgia.

[8] For approximately 95 percent of the wire centers, the CPM and BCM2 results are within 30 percent of each other.

encouraging factor, particularly in urban wire centers that have a relatively high percentage of access lines.

D. Hatfield Model

Despite its continuous revisions, the Hatfield model still suffers from numerous deficiencies. Attachment 3 is a paper prepared by Dr. William Taylor and Dr. Aniruddha Banerjee that discusses these deficiencies from an economic perspective.

Because the Hatfield model is in a state of constant change and that many of the algorithms have not been disclosed, it is difficult to fully evaluate and analyze the model. BellSouth has compared the 1994 study with the 1996 study. As shown on Attachment 4, the 1996 study produces lower local service costs than the 1994 study for every population density range.[9] The cost reductions are the most dramatic in densely populated zones. For the zone of 1000-5000 people per square kilometer, the cost decreased from $14.19 in 1994 to $9.16 in 1996. This represents a 35 percent change in two years. For the zone of greater than 5000 people per square kilometer, the 1996 model produces a cost result that is 55 percent lower.[10] It would appear that the revisions to the Hatfield model are result driven and the model can be adjusted to produce whatever cost answer its sponsors desire.

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9 Both the 1994 and 1996 studies employed the same six density ranges.

10 In 1994, the cost produced by the Hatfield model was $18.32, in 1996, the cost decreased to $8.26.

III. CONCLUSION

BellSouth continues to believe that universal service support should be based on book costs. In the event, however, the Joint Board were to recommend the use of a proxy model, then it should select a model that is sound from engineering and economic perspectives. In this regard, both the BCM2 and CPM models are superior to the original BCM model or the Hatfield model. BellSouth believes the best aspects of the BCM2 model and the CPM model can be merged into a single model and is participating with an industry group to achieve such a result.

No model will be perfect. Accordingly, it is imperative that if a proxy approach is used, it must be implemented in a revenue neutral manner. Local exchange carriers must be afforded the opportunity to recover their actual costs. A proxy model approach cannot be used to substitute the model's results for a carrier's actual costs, nor can they be used to arbitrarily reduce rates beyond the support received through the new universal service fund.

Respectfully submitted,

BELLSOUTH CORPORATION and
BELLSOUTH TELECOMMUNICATIONS, INC.

Their Attorneys

By: ______________________

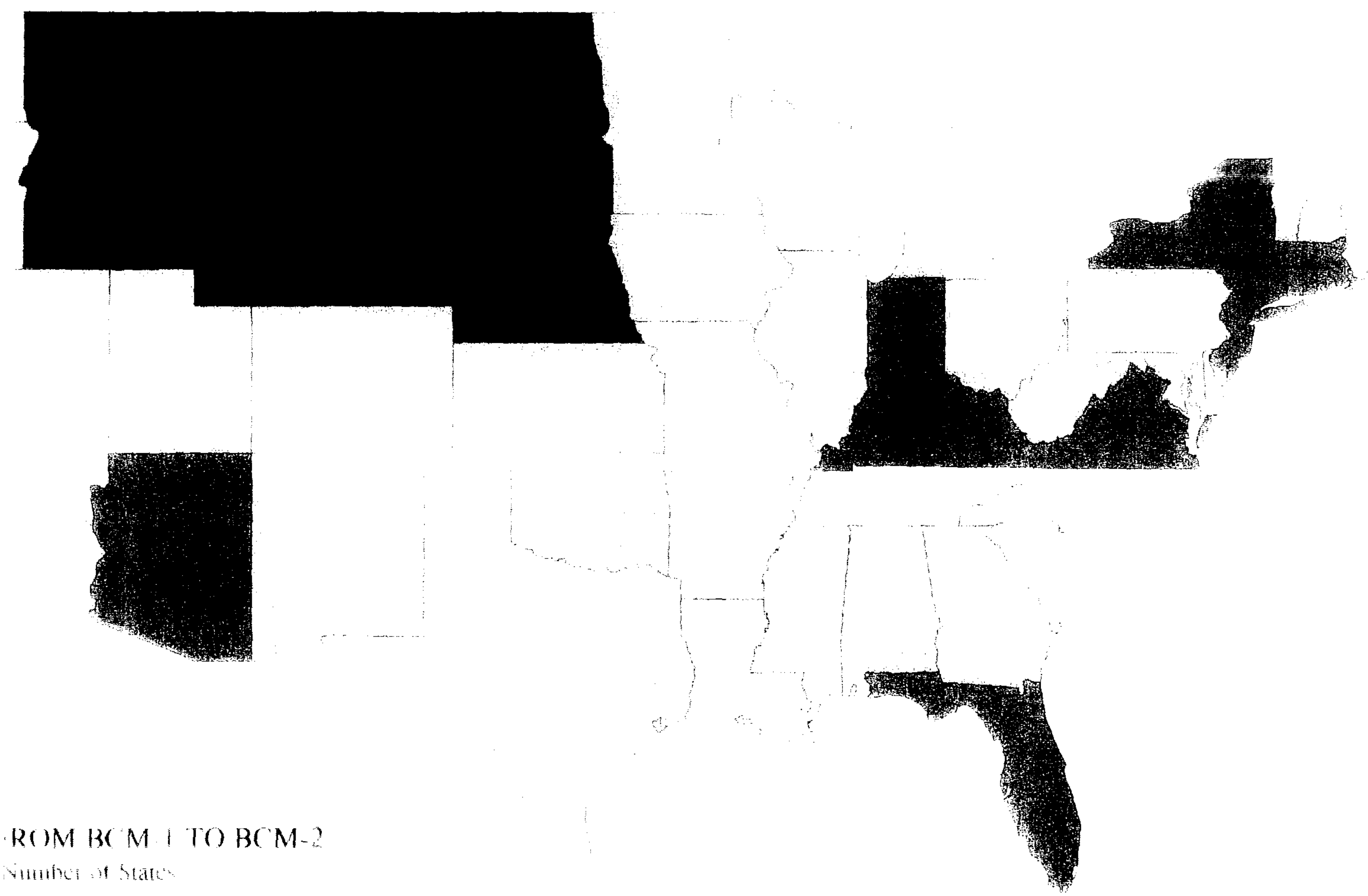
M. Robert Sutherland
Richard M. Sbaratta
Rebecca M. Lough

Suite 1700
1155 Peachtree Street, N.E.
Atlanta, Georgia 30309-3610
(404) 249-3386

DATE: August 9, 1996

ATTACHMENT 1

State Comparison of Change From BCM-1 (ACF#1) to BCM-2



% CHANGE FROM BCM-1 TO BCM-2

( ) Number of States

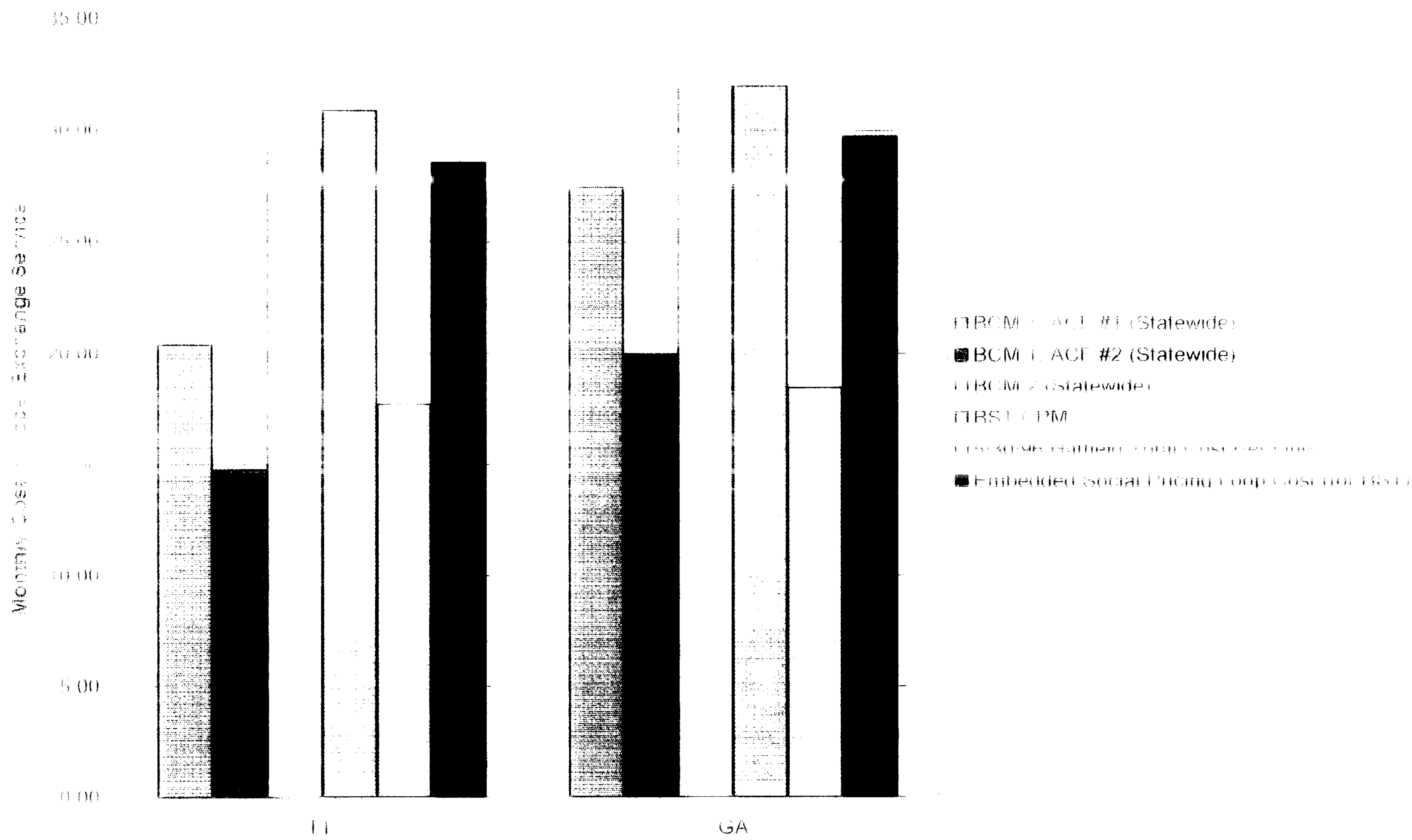
- 30% to 0% (6)
- 0% to 30% (32)
- 30% or Greater (11)

Comparison of CPM & BCM-2

BellSouth - Florida Wire Centers

ATTACHMENT 2

COMPARISON OF COST RESULTS



ATTACHMENT 3

NATIONAL ECONOMIC
RESEARCH ASSOCIATES

nera
Consulting Economists

COMMENTS OF

WILLIAM E. TAYLOR AND ANIRUDDHA BANERJEE

Before the Federal Communications Commission

CC Docket No. 96-45

August 9, 1996

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Comments of
William E. Taylor, Ph.D., and Aniruddha Banerjee, Ph.D.

I. Introduction and Summary.

We are William E. Taylor, Senior Vice President of National Economic Research Associates, Inc. (NERA), head of its telecommunications economics practice and head of its Cambridge office, and Aniruddha Banerjee, Senior Consultant at NERA. Our business address is One Main Street, Cambridge, Massachusetts 02142.

Dr. Taylor has been an economist for over twenty years. He received a B.A. degree in economics (Magna Cum Laude) from Harvard College in 1968, a master's degree in statistics from the University of California at Berkeley in 1970, and a Ph.D. in Economics from Berkeley in 1974, specializing in industrial organization and econometrics. He has taught and published research in the areas of microeconomics, theoretical and applied econometrics, and telecommunications policy at academic institutions (including the economics departments of Cornell University, the Catholic University of Louvain in Belgium, and the Massachusetts Institute of Technology) and at research organizations in the telecommunications industry (including Bell Laboratories and Bell Communications Research, Inc.). Dr. Taylor has participated in telecommunications regulatory proceedings before state public service commissions and the Federal Communications Commission ("FCC" or the "Commission") concerning competition, incentive regulation, price cap regulation, productivity, access charges, pricing for economic efficiency, and cost allocation methods for joint supply of video, voice and data services on broadband networks.

Dr. Banerjee received B.A. (with Honors) and M.A. degrees in Economics from Delhi University, New Delhi, India, and a Ph.D. in Agricultural Economics from the Pennsylvania State University in 1985 He has taught undergraduate and graduate Economics courses in microeconomics, industrial organization, public finance, and statistics and econometrics. He has published papers on futures markets and has made several presentations on demand and cost analysis, and regulatory and competition policy in telecommunications. Prior to his present appointment at NERA, Dr. Banerjee has held positions with AT&T, Bell Communications Research, and BellSouth Telecommunications. He has participated in or contributed to several state and federal regulatory proceedings in the U.S. and Canada.

We have prepared our comments at the request of BellSouth Telecommunications, Inc., to appraise the Hatfield 2.2, Release 1, economic cost model ("Hatfield model" or "model") submitted by MCI Communications Corporation and AT&T Corporation on July 5, 1996, in CC Docket 96-45. This follows publication of the FCC's Public Notice on July 10, 1996, seeking comments on the Hatfield model and the Benchmark Cost Model 2.

Our primary conclusion from an appraisal of the Hatfield model is that it is fundamentally flawed and ill-suited to the task of determining a carrier's cost of supplying basic residential service. Because of this, we recommend that the model — as presently constructed — not be used for the purpose of determining the true costs of the universal service program or the size of the support fund being contemplated under universal service reform. At present, there are just too many questionable assumptions embedded in, or results derived from, the model to render it of any value for that task.[1]

II. BACKGROUND

As the Commission has turned its attention to universal service reform — an important component of changes contemplated by Section 254 of the Telecommunications Act of 1996 — it has sought specifically to address the task of sizing the amount of support needed to administer the universal service program under local exchange competition. Comments and Reply Comments in CC Docket 96-45 brought forward submissions from various parties of engineering models intended to measure the economic cost of providing basic residential

[1] Essentially the same conclusions have been reached by Timothy J. Tardiff in *Economic Evaluation of Version 2.2 of the Hatfield Model*, prepared for GTE, July 9, 1996.

exchange service. These models include the Benchmark Cost Model ("BCM"), originally submitted in CC Docket 80-286 by its sponsors (MCI Communications Corporation, NYNEX Corporation, Sprint Corporation, and US West, Inc.), the Cost Proxy Model ("CPM") submitted by Pacific Bell, the Benchmark Cost Model 2 ("BCM2") submitted by Sprint Corporation and US West, Inc., and the Hatfield Model (Version 2.2, Release 1) submitted by MCI Communications Corporation and AT&T Corporation.

To understand how these models compare for the purpose of generating benchmark cost ranges for network functions and services, in general, and basic residential exchange service, in particular, the FCC, on July 10, 1996, issued a Public Notice in CC Docket 96-45, asking interested parties to comment on the models. At the request of BellSouth Telecommunications, Inc., we provide below our analysis of the Hatfield model (and of the BCM, to the extent necessary) and our conclusions regarding that model's usefulness.

III. General Summary of Issues

Our analysis of the Hatfield model begins with its set of underlying assumptions and postulates. Some of those assumptions are explicit. For example, the model assumes that existing networks respond to increases in demand in a "scorched node" fashion, i.e., their existing wire center locations remain fixed even as the networks are otherwise reconstructed to serve new demand.[2] The model also makes several assumptions about technical or engineering parameters that drive estimates of cost. These include, for example, "fill factors" (or, utilization rates), placement of feeder and distribution plant, density zones, and the distribution of businesses or households within the density zones.[3] The model also makes some important

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[2] *Documentation of the Hatfield Model, Version 2.2, Release 1*, ("Hatfield Document"), Boulder, CO: Hatfield Associates, Inc., May 16, 1996, filed in CC Docket 96-45 on July 5, 1996, on behalf of MCI Communications Corporation and AT&T Corporation. See, especially, p. 3.

[3] In fact, some of these assumptions are borrowed by the Hatfield model from the BCM where they first appeared. This is because the Hatfield model relies substantially on the BCM for calculating the costs associated with loop investments.

— and, as we argue below. disputable — assumptions about financial parameters such as those involved in calculating the weighted cost of capital or for converting capital expenditures into annualized expenses.

The model's results also appears to make several implicit assumptions that are significant influences on the model's cost outcomes. Even if those assumptions were never intended to be made, it is safe to say that the cost outcomes only make sense if those assumptions are indeed made. A significant part of our critique of the Hatfield model focuses on these unstated assumptions and the extent to which they are responsible for cost estimates that we believe to be neither credible nor acceptable.

By construction, every model is an abstraction of reality, and assumptions about the model are frequently made to keep the necessary calculations tractable. The Hatfield model's assumptions or premises, however, often appear untenable for both engineering and economic reasons. Specifically, several of its technical assumptions (regarding engineering parameters) are flawed in light of current best engineering practices and have the effect of biasing cost estimates significantly downwards. The model's hidden economic assumptions — which also lead to understated costs — are particularly questionable. Some of these economic assumptions appear to be as follows:

1. Costs estimated for the so-called *average* or hypothetical network (that presently does not exist) are sufficient to inform public policy deliberations about the pricing of an *actual* network's unbundled services or the *actual* costs of the universal service program. Any departure of an incumbent LEC's costs from the "benchmark" costs of a hypothetical network must be regarded as *prima facie* evidence of inefficiencies in the LEC's operations.

2. Incumbent and entrant LECs alike will pursue identical strategies and technology choices despite their very different starting points under competition. For example, an incumbent and an entrant — both in pursuit of the most efficient, forward-looking network for serving future demand — will somehow opt for the same choice of technology and architecture. If those choices differ, then the *incumbent's* preferences regarding technology and network upgrades must be considered suspect and inefficient.

3. The local exchange market in which entrant firms will compete with incumbent local exchange carriers (LECs) will retain many vestiges of its monopoly past. For example, the low regulatorily-prescribed depreciation rates will continue to remain relevant under

competition, and so will cost-of-capital or hurdle rates that reflect the considerably lower risks associated with regulated monopoly markets. Also, the scale economies which accrue to regulated monopolies as single providers of service will continue to be available to multiple, competing LECs who (in the process of sharing the market) may only serve demand segments that are smaller than the entire market.

We explain below how these assumptions taint fundamentally the usefulness of the Hatfield model for the purposes of implementing universal service reform as contemplated in Section 254 of the Telecommunications Act of 1996 and the present docket.

IV. Analysis of Specific Issues/Assumptions in the Hatfield Model

A. The Hatfield Model's Approach to Cost Estimation

The Hatfield model is primarily an engineering model of cost. It is a "bottoms-up" model that builds to service- or function-level cost by making several assumptions and specifications about the elements and piece parts that make up the service or function. It contains cost modules that calculate the investment costs of loop plant and wire center operations (switching, signaling, operator, and inter-office facilities). To costs of total plant investments the model adds annual service expenses related to the provision of services and unbundled functions. It reports the compiled investment requirements and expenses at the summary level desired, e.g., for individual functions like loop distribution, end-office switching, or signaling links, or for services like basic residential exchange service.

While such an engineering approach to estimating cost is necessary to account for the several hundreds, or even thousands, of components that make up a network, it often has to rely on facilitating assumptions (such as the use of multiplicative "factors" or ratios) to account for several *non*-network related and non-investment costs. Second, the engineering approach must make several assumptions about the prices at which network components would be purchased, or even the pricing structures (discounts, etc.) themselves. Third, that approach must postulate the utilization rate past which the network would consider expanding capacity despite having spare capacity on hand. Fourth, the engineering approach must make assumptions about the distribution of customers (by density zones, by proximity to the serving wire center, etc.) in order to construct the most efficient network layout needed to serve those customers. In the process, assumptions must be made about the type and configuration of outside plant (copper or fiber cable, aerial or buried cable, feeder and distribution loops, loop concentrators, etc.) and end-office equipment (digital or analog switches, signaling systems, operator systems, transport, etc.). Finally, assumptions would be needed for the physical, topographical, and climatic features of the geographic areas that are served by the network. For example, the Hatfield model — as the BCM before it — contains assumptions about rock hardness, surface conditions, water table depth, etc., all of which have implications for the mix and type of structures (poles, trenches, conduit, etc.) used for housing outside plant.

A cost model that depends on assumptions about so many crucial parameters must be judged by two criteria: (i) how well can its assumptions and cost estimates represent or reproduce those of an *actual* network? and (ii) how easily can it be modified to accommodate a network's historical circumstances and future technology and operational choices, given the increasing uncertainty about demand engendered by greater market competition and reduced regulation?

The first criterion recognizes that engineering estimates of economic costs are, at best, hypothetical, namely, the costs that would be realized were the network, in reality, to conform exactly to the assumptions made for it. Differences between engineering costs and actual (or, *booked*) costs are natural and should be expected. Given that engineering costs are usually lower than booked costs, the model must be capable of being modified in order to reconcile or explain the discrepancy between hypothetical and actual costs. The second criterion tests the model's flexibility on its economic merits, i.e., primarily its ability to produce cost estimates that reflect the changing market and regulatory environment, rather than just the setting initially assumed for it.

B. The Hatfield Model Does Not Produce Costs for an Actual Network

1. Model Design Skewed Toward Hypothetical Network

Because of its numerous assumptions about technical parameters, the engineering approach has a built-in potential to mis-estimate a network's actual costs. This problem is likely to be aggravated when the technical parameters entered as model inputs represent *not* the specific network being modeled but rather an entirely hypothetical or "average" network. The sponsors of the model openly acknowledge its orientation toward a hypothetical network.

> The Hatfield Model develops estimates of the economic costs (TSLRIC) of providing local telephone services by determining the specifications of a local network, using most efficient practices and best forward-looking technologies, to meet the total demand for local narrowband telephone services. By doing this, *the model simulates the construction and operations decision-making of an efficient local service provider that must create and operate a new network to meet current and reasonably forecasted demand levels* for narrowband telephone services. In simulating the construction of these *hypothetical* networks, the model incorporates realistic assumptions concerning the LECs' ability to adopt and implement efficient, cost minimizing production techniques.[4]

> The model sponsors add:

> The technologies considered in the Model are forward-looking. As such, they are those an efficient LEC *would* adopt if it were to *begin today to rebuild its telephone service network from the bottom up.*[5]

Despite its sponsors' claims that the Hatfield model incorporates "realistic assumptions" about (presumably, incumbent) LECs' networks and their abilities to implement new, more efficient production techniques, it is abundantly clear that the model is intended for no such purpose. First, the Hatfield model depends in substantial part on outputs of the BCM model for which *its* sponsors had the following goal:

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[4] Hatfield Document, p. 2. Emphasis added.

[5] Hatfield Document, pp. 2-3. Emphasis added.

> The BCM does *not* define the *actual* cost of any telephone company, nor the embedded cost that a company might experience in providing telephone service today. Rather, the BCM provides a benchmark measurement of the relative costs of serving customers residing in given areas, i.e., the [Census Block Groups].[6]

Second, among other things, the Hatfield model's sponsors (i) freely admit to not using LECs' actual fill factors,[7] (ii) make arbitrary and uniform assumptions about "line multipliers" meant to account for business and other lines that the BCM leaves out,[8] (iii) input into the model not actual prices paid by LECs for local network components but those constructed by the model developers themselves,[9] and (iv) use an AT&T report on *inter*-exchange capacity expansion costs to calculate a *LEC's* tandem switching investments.[10]

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[6] *Benchmark Cost Model.* A Joint Submission by MCI Telecommunications Corporation, NYNEX Corporation, Sprint Corporation, and US West, Inc., in CC Docket 80-286, September 12, 1995. See, especially, p. 3. Emphasis added.

[7] Hatfield Document, p. 3, wherein the now-familiar but unproven assertion is made that LECs' actual fill factors reflect built-in LEC inefficiencies.

[8] Hatfield Document, p. 12. It is noteworthy that no attempt whatsoever is made to base the line multipliers on actual data for a LEC from a representative sample of its CBGs. Instead, the Hatfield model uses an iterative fitting technique that produces a uniform ratio of business-residence lines across all CBGs. This is justified by claiming that "... although specific CBGs may exhibit exceptions from ... trend, at higher levels of aggregation (e.g., the wire center or LATA level), the mix of services will progressively approach the total company mix reported in ARMIS data." Ironically, its sponsors have no intention of modifying the model to use *actual* data on business lines instead of the arbitrary multipliers (see pp. 132-133 of the Transcript of the Pre-Hearing Conference before Administrative Law Judge Kirk McKenzie, Case R. 93-04-003, P.U.C., California, July 12, 1996). This position is taken even though a public source for such data has been identified and employed by a new version of the BCM model called "BCM2" (see Executive Summary of a press release, *Sprint & US West Refine Previous Benchmark Cost Model and Deliver to FCC*, Washington D.C., July 11, 1996).

[9] Hatfield Document, p. 24. The sponsors state: "While actual prices paid for these components and their network characteristics may vary from carrier to carrier, [Hatfield Associates, Inc.] has developed a set of standard input values, based on public data sources and *the informed judgments of its engineers and other industry experts.*" Emphasis added.

[10] Hatfield Document, p. 38

2. BCM's Deficiencies are Shared by the Hatfield Model

In adopting the BCM virtually in its totality for calculating loop investments, the Hatfield model also retains the BCM's infirmities. The BCM often assigns Census Block Groups (CBGs) to the wrong wire center, a clear demonstration that the hypothetical network constructed by the BCM does not correspond to the actual, physical network. This problem is, in principle, correctable if intervening topographical features such as rivers, lakes, and mountains are taken into account when mapping a CBG to a wire center. When such intervening features are present, sheer proximity alone of a CBG to a wire center may not be sufficient reason for assigning it to that wire center. Where geography requires that a CBG be assigned to a more distant wire center, the actual cost of loop plant will likely exceed that calculated for an assignment based purely on proximity. Neither the BCM nor the Hatfield model adjusts for these topographical features.

For calculating the placement of feeder and distribution plant, the BCM assumes that loop feeders and sub-feeders emanate from the wire center only up to the edge of a square-shaped CBG. Within the CBG, the BCM assumes a uniform distribution of households and the placement only of distribution plant. These assumptions may often be untenable and produce average loop lengths and investment costs that are quite different in reality. The Hatfield model's sponsors recognize this limitation but fail to explore its full ramifications. The model sponsors claim that "[b]ecause populations tend to cluster in towns and subdivisions, the BCM assumption of uniform population distribution tends to overstate distribution distance and thus the required loop investment."[11] This implies that the error in the estimated cost is only one way — toward *over*-estimation. In fact, under-estimation of cost could occur, in principle, for a large CBG in a low-density zone where the population clustering occurs not at the geometrical center of that CBG, but in several spots more widely dispersed from the center than would be assumed under a uniform distribution.

[11] Hatfield Document, p. 16.

In addition, the Hatfield model documentation reports that there are economies of scale (i.e., falling unit costs) in the deployment of copper or fiber cables. For example, the unit cost declines from 1.26¢ to 1.14¢ to 0.61¢ per foot of buried copper cable for cable sizes of 100, 400, and 4,200 (the presumed maximum deployment within a CBG), respectively.[12] Similarly, the unit cost declines from 6.58¢ to 4.13¢ to 3.86¢ per foot of buried fiber cable for cable sizes of 12, 48, and the maximum 144, respectively. Similar economies are observed for aerial copper or fiber cable. Since the BCM works with CBGs, rather than the actual distribution areas employed by LECs, it is quite possible for the BCM (and the Hatfield model) to assign larger cable sizes (and, therefore, to experience greater economies of scale) to a densely-populated CBG than the cable sizes actually deployed by LECs in their largest distribution areas. For example, while the BCM's maximum deployments are 4,200 feeder cable pairs and 3,600 distribution cable pairs, the largest actual deployments in California are 3,600 feeder and 1,800 distribution cable pairs by Pacific Bell and 3,000 feeder pairs by GTE.[13] Under these circumstances, the BCM assumptions would tend to overstate the economies of scale and, hence, to understate the true costs of LECs' actual loop plant.

Finally, the BCM assumes that each CBG is served by four equal distribution legs.[14] This can be problematic for calculating the cost of support structures used for housing the deployed cables. The BCM's (and the Hatfield model's) current practice is to calculate that cost by applying a multiplier or "factor" to the price of cable. As demonstrated by an example provided by Timothy Tardiff, if the actual number of distribution routes in fact exceeds four, the BCM will understate the component of the cost of structures that varies with route miles.[15]

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[12] Hatfield Document, p. 28. All unit costs are computed from Tables 17 and 18.

[13] Tardiff, *op cit.*, pp. 8-9.

[14] *Benchmark Cost Model*, p. 11.

[15] Tardiff, *op cit.*, pp. 8-9. Tardiff also reports that GTE estimated that doubling the number of distribution routes raises installation and structure costs by 49 per cent, rather than the 17 per cent predicted by the BCM. This and other discrepancies between BCM-reported and actual costs loom even larger when it is realized that roughly half of a switched network's total cost arises from its distribution plant.